Unit 6

Seed Production

Introduction

There is a wide genetic variation in paddy plants across regions, which is because of genetic changes that keep occurring naturally by mutation, re-combination and other genetic or environmental factors. Plant breeders combine genes to develop more adaptable, competitive, healthy and productive varieties. Dwarf high yielding varieties (HYVs) have higher yield potential as compared to traditional tall varieties being cultivated for over centuries across the world.

Session 1: Methods of Seed Production

Seed is a reproduction unit of a flowering plant. But botanically, it is a matured ovule consisting of a living embryo with stored food material enclosed in a protective coat. A seed can produce a new plant. Among the various crop production inputs, seed is one of the most important components.

The purpose of seed production of improved varieties is to grow crops in different seasons and regions in varied growing conditions and production systems across the country. This justifies the wide presence of seed industry.

Rice is a self-pollinated crop and its seeds can be produced from the previous harvest, except hybrids. For hybrids, the seeds need to be purchased for every new planting. A quality seed must:

- have genetic purity and uniformity.
- conform to the standards of a particular cultivar.
- be disease-free and viable.
- be free from admixtures of other crop seeds, weeds and inert matter.
- have acceptable uniformity with respect to size, shape and colour.

Importance of seed production

Seed is the basic input for crop production. Quality seed alone contributes to about 20–25 per cent of the crop output. However, this output can be further increased by up to 45 per cent with efficient management of other required inputs or resources. A superior quality seed not only increases crop productivity per unit area but also fetches higher price in market and enhances milling recovery, thereby, increasing the income of farmers. Seed purity is an important factor to be considered while producing paddy seed. Paddy is a self-pollinated crop so it is easy to maintain seed purity. The seed production systems for hybrids are not easy as paddy plant contains both male and female organs. Thus, cross pollination in paddy involves separate maintenance of male and female parents. The points that must be taken into account for seed production are as follows.

- Select a land that is free from weeds, soil-borne diseases and infections, etc.
- One must have knowledge about the cropping history of the field at the time of field selection.
- There must be sufficient isolation distance of the seed production field (as recommended) from other rice fields to avoid contaminants of foreign pollen.

Seed production system in India

The seed sector in India is of two types, namely formal and informal.

Formal seed sector

In this sector, seeds are produced scientifically (conventional method) and all certification procedures and standards to produce a particular variety of seed are followed.

Informal seed sector

It is the sector, farmers produce seeds without following the certification procedures and exchange it amongst themselves. It is a traditional method of seed production.

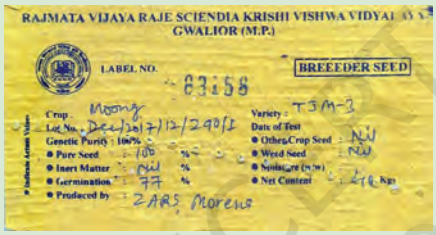
Table 6.1: Difference between scientific and traditional method of seed production

Scientifically produced seeds	Traditionally produced seeds
Planned seed production programme is followed.	No planned seed production programme is followed.
The seed production process follows quality standards, i.e., removal of diseased, off-type and weed plants.	No such process is followed.
Seeds have high germination percentage.	Germination percentage is not assured in such seeds.
Processing, treatment, packaging and labelling procedures are followed.	No such procedure is followed.
Controlled drying of seeds is done.	There is uncontrolled drying of seeds, which affects the seed quality.
Seeds are stored to maintain their vigour and viability.	The seeds are protected from insect–pests and diseases not for vigour and viability.
Seeds cannot be converted into grain unless directed by a seed inspector.	Seeds can be utilised for commercial grain purpose.
Varietal purity can be identified from its breeder seed.	Varietal purity is not known.

A seed production programme largely adheres to a series of successive generations, i.e., breeder, foundation and certified seed (see Table 6.2). There is a need to

adopt safety measures and quality assurance principles in seed production system at all times so that a farmer gets the best seeds.

Table 6.2: Types of seed

S. No.	Seed type	Tag size and colour	Features
1.	Nucleus seed	Nil	• Not for sale and farmers' use • No physical impurity • Genetically, 100 per cent pure • Produced by authorised breeder or state agriculture universities or institutes • Isolation distance and production process followed strictly
2.	Breeder seed	12×6 cm Golden yellow colour  *Fig. 1: Breeder seed tag*	• Produced from nucleus seed • Produced under strict supervision for maintaining genetic and physical purity as per the set standards
3.	Foundation seed	15×7.5 cm White colour  *Fig. 2: Foundation seed tag*	• Produced from breeder seed • Can be produced by private or government agencies under strict supervision for standards by supervision agencies
4.	Registered seed	15×7.5 cm Purple colour	• Produced from foundation seed • Produced by registered seed growers • Genetic purity is maintained under specific standards

5.	Certified seed	15×7.5 cm Azure colour  *Fig. 3: Certified seed tag*	• Produced from foundation seed • Produced by registered seed growers under the supervision of seed certifying agencies • Genetic and physical purity of seed as per the set standards ensured
6.	Truthful labelled seed	 15×10 cm Opal green colour *Fig. 4: Truthful labelled seed tag*	• Labelling is compulsory • Seed must have gone through germination, viability and physical purity test

Isolation distance and rouging

Isolation

Optimum isolation is important to ensure genetic purity of parental and hybrid seeds. The isolation distance for cross-pollinated crops is 500 metre. Being a self-pollinated crop, paddy requires an isolation distance of 3–5 metre for a seed production plot. No other crop must be grown in this 'isolation distance area'. To further minimise chances of pollen contamination of the seed production plot from other genotypes, these practices can be followed.

- Physical barriers, such as natural means like mountains, forests and rivers can be used.
- Taller crops like sorghum (*jowar*), maize, pearl millet (*bajra*), sesbania (*daincha*), etc., can be

grown around short stature crops like paddy, groundnut, chick pea, etc. These barrier crops are planted, covering a band of 3 metre all around the seed production plot.

Roguing

'Roguing' means identifying and removing plants of same species or crop with undesirable characteristics from a field to preserve the quality of the crop being grown there. It is important to maintain the purity of seeds of a genotype (variety or hybrids). It is a continuous process in the seed production plot as off-type plants may appear at any growth stage in the field. Roguing at different growth stages is discussed below.

Roguing at vegetative phase

Plants that appear different from the requisite or established features of the parental variety are removed (rogued out). Leaf shape, size, colour, leaf sheath, nodal or intermodal regions, plant height and other visible features can be used to identify rogues.

Roguing at flowering stage

Early and late flowering types, absence or presence of awns, panicle exertion, anther colour, panicle characteristics, etc., can serve as criteria for roguing out.

Roguing at maturity stage

It involves roguing out plants based on the size, shape and colour of the seeds.

Field inspection

A minimum of two inspections need to be conducted each during the vegetative and reproductive stage.

Tale 6.3: Isolation distance

Fields	Foundation seed plot	Certified seed plot
Fields of other varieties	3 m	3 m
Fields of same variety not conforming to varietal purity requirements for certification	3 m	3 m

Table 6.4: Specific requirements (maximum permitted)

Factors	Foundation seed (%)	Certified seed (%)
Off-types	0.05	0.02
Objectionable weed plants	0.01	0.02

Table 6.5: Seed standards

Factors	Standards for foundation seed	Standards for certified seed
Pure seed (minimum)	98%	98%
Inert matter (maximum)	2%	2%
Huskless seeds (maximum)	2%	2%
Other crop seeds (maximum)	10 seeds/kg	20 seeds/kg
Other distinguishable varieties (maximum)	10 seeds/kg	20 seeds/kg
Total weed seeds (maximum)	10 seeds/kg	20 seeds/kg
Objectionable weed seeds (maximum)	2 seeds/kg	5 seeds/kg
Seeds infected by paddy bunt (maximum)	0.1%	0.5%
Germination (minimum)	80%	80%
Moisture (maximum)	13%	13%
For vapour-proof containers (maximum)	8%	8%

Practical Exercise

Activity

Perform roguing in a paddy field.

Material required: sickles, *khurpi*, gumboot, gloves, herbarium file, pen, pencil, eraser, etc.

Procedure

- Visit a nearby paddy field.
- Identify weeds and off-types of paddy plant being grown there.
- Rogue the off-type plants and weeds.
- Prepare a herbarium file and note down the characteristics of the weeds found there.
- Present it before the class.

Check Your Progress

A. Fill in the Blanks

1. Seed is a _____ unit of a flowering plant.
2. Botanically, seed is a matured _____.
3. The seed sector in India is of two types, namely _____ and _____.
4. An isolation distance required for a seed production paddy plot is _____ metre.
5. A practice of identifying and removing undesirable characteristics in plants from a field is called _____.

B. Multiple Choice Questions

1. Seed production technique involves _____.
   (a) isolation distance (b) roguing
   (c) seed standards (d) All of the above
2. Standard for certified seeds for minimum germination is _____ per cent.
   (a) 92 (b) 80 (c) 96 (d) 98
3. Field inspection must be done at the _____ stage.
   (a) vegetative (b) reproductive
   (c) nursery (d) Both (a) and (b)
4. Breeder seed is produced from _____ seed.
   (a) nucleus (b) foundation
   (c) certified (d) registered

C. Match the Columns

A	B
1. Breeder seed	(a) Opal green colour
2. Foundation seed	(b) Azure blue colour
3. Certified seed	(c) Golden yellow colour
4. Truthful labelled seed	(d) White colour

D. Subjective Questions

1. Describe the types of seed sector in India.
2. Why is isolation distance needed for seed production?
3. Discuss the seed standards for paddy varieties.
4. Write short notes on the following.
   (a) Nucleus seed
   (b) Breeder seed
   (c) Foundation seed
   (d) Certified seed

Session 2: Improved and Indigenous Rice Varieties in India

Improved crop varieties had played a prominent role in the inception of Green Revolution in India. These are high yielding varieties (HYVs) and are resistant to diseases and insect–pests. It is, therefore, important to emphasise on the production of quality seeds of high yielding varieties or hybrids of field crops. The Government of India has consistently been trying to bring about qualitative improvement in seeds in order to increase the yield. Efforts are also underway to ensure that the seeds and fields are free of diseases and insect–pests, and are drought resistant.

High Yielding Variety

High Yielding Variety (HYV) seeds were the basic component of Green Revolution. HYVs yield higher crop productivity per unit area. These varieties are typically dwarf in stature, non-lodging, highly responsive to fertilisers, irrigation and other farm inputs. Some of them mature early.

Table 6.6: HYVs of rice for upland ecosystem

Name of the variety	Year of release	Duration (days)	Yield potential (t/ha)
Anjali	2003	90	3.5
Sadabahar	2003	105	3.5
Hazari dhan	2003	120	5
Virendra	2006	90	4.5

Upland rice ecosystem

Paddy crop occupies an area of about 6 million ha (3.5 per cent of the total area). The main upland rice growing States are West Bengal, Bihar, Assam, Chhattisgarh, Odisha, north-eastern hill region and eastern Uttar Pradesh. This area mostly practices DSR cultivation. Productivity of this ecosystem is low, unpredictable and unstable due to drought, weeds, less fertile soil, nutritional imbalances, poor cultural practices, poor yielding cultivars, higher incidence of diseases and insect–pests, etc.

Irrigated rice ecosystem

Under this ecosystem, paddy crop is cultivated in about 22 million hectares (49.5 per cent of the total area under rice cultivation). Irrigated and wetland rice necessitates the construction of bunds, which help in effective and efficient use of water resources, including rains. The major irrigated rice cropping systems in India are rice–rice, rice–rice–rice and rice–wheat. Yields of 4–5 t ha^{-1} are common. HYVs suitable for this system are shown in Table 6.7.

Table 6.7: HYVs of rice for irrigated ecosystem

Name of the variety	Duration (days)	Yield potential (t/ha)
Satabdi	120	8
Naveen	120	5
Geetanjali (aromatic)	135	5
Rajalaxmi (hybrid)	135	7
Ajay (hybrid)	135	7
Abhishek	120	5
Chandrama	125	5
Satya Krishna	135	5.5–6
Chandan	125	5.5–6

Hybrid rice

Hybrid varieties of rice are more robust, tillering, nutrient responsive, higher yielding and better than common HYVs. Hybrids are less susceptible to diseases, drought and other agronomic vagaries. Hybrid rice cultivation has picked up pace since the last decade. It is popular in Uttar Pradesh, Bihar, Jharkhand, Madhya Pradesh and Chhattisgarh. Hybrid rice cultivation is bound to emerge as a private sector seed industry. Hybrids with new features are being introduced in India every year.

Table 6.8: State-wise rice hybrids recommended in India

State	Hybrids
Andhra Pradesh	APHR–1, APHR–2, PHB–71, PA–6201, PA–6444, RH–204, *Suruchi*, DRRH–1, GK–5003, PAC–837, US–312, DRRH–3, NK–5251
Bihar	KRH–2, PA–6201, *Ganga*, JKRH–401
Chhattisgarh	*Indra Sona*, *Suruchi*, HRI–157, DRH–775, PAC–837
Delhi	PRH–10
Gujarat	*Suruchi*, KRI–157, PAC–835, PAC–837, DRRH–3, NK–5251
Goa	KRH–2
Haryana	PRH–10, *Ganga*, HKRH–1, PHB–71, RH–204, *Suruchi*, DRRH–2, *Sahyadri*–4
Karnataka	KRH–1, KRH–2, PHB–71, PA–6201, PA–6444, RH–204, *Suruchi*, GK–5003, PAC–837, HRI–157, US–312, NK–5251
Maharashtra	KRH–2, PA–6444, *Suruchi*, *Sahyadri*–1, *Sahyadri*–2, *Sahyadri*–3, *Sahyadri*–4, NK–5251
Madhya Pradesh	PA–6201, JRH–4, JRH–5, JRH–8, HRI–157, DRRH–3
Odisha	KRH–2, PA–6201, PA–6444, *Ganga*, *Suruchi*, *Rajlaxmi*, *Ajay*, JKRH–401, PAC–835, DRRH–3
Punjab	PRH–10, *Ganga*, PHB–71, PA–6129, *Sahyadri*–1
Puducherry	KRH–2, PA–6129, HRI–157
Rajasthan	KRH–2, RH–204
Tamil Nadu	ADTRH–1, CORH–3, CORH–2, PHB–71, PA–6201, RH–204, DRRH–2, PA–6129, US–312, MGR–1, KRH–2, NK–5251
Tripura	PA–6201, KRH–2, PA–6444
Uttar Pradesh	HRI–157, US–312, DRRH–3, KRH–2, *Pant Sankar Dhan*–1, *Pant Shankar Dhan*–3, PHB–71, PA–6201, PA–6444, *Narendra Sankar Dhan*–2, PRH–10, *Ganga*, *Narendra Usar Sankar Dhan*–3, *Sahyadri*-4
Uttarakhand	DRRH–2, RH–204, *Pant Shankar Dhan*–1, PA–6444, *Pant Sankar Dhan*–3, *Ganga*
West Bengal	KRH–2, CNRH–3, PA–6201, DRRH–2, JKRH–401, *Sahyadri*–4, DRH–775, US–312
Jharkhand	DRH–775
Jammu and Kashmir	PA–837

NOTES

Aromatic rice

There exists a number of rice varieties or hybrids that are aromatic. All *basmati* rice varieties are aromatic. But all aromatic rice varieties are not *basmati*. *Basmati* rice is mainly produced in the Indo-Gangetic plains. Best quality *basmati* rice is produced in warm, humid and valley-like conditions. Some of the important aromatic rice varieties are given in Table 6.9.

Table 6.9: Aromatic rice varieties in India

Variety	Duration (days)	Yield (t/ha)	States	Remark
Pusa RH-10 hybrid	125	5–5.5	Punjab, Haryana, Delhi, Western Uttar Pradesh and Uttarakhand	Moderate resistance to blast disease and fine grained
Pusa *Sugandha–2*	125–130	4.0–5.0	Punjab, Haryana, Delhi, Western Uttar Pradesh and Uttarakhand	Moderate resistance to blast and fine grained
Pusa *Sugandha–3*	125–130	4.0–5.0	Punjab, Haryana, Delhi, Western Uttar Pradesh and Uttarakhand	Moderate resistance to blast disease and fine grained
Basmati	130–140	4.5–5.0	Jammu and Kashmir, Himachal Pradesh, Punjab, Haryana, Delhi, Uttarakhand and Western Uttar Pradesh.	Resistant to blast disease and long slender grains
Pusa *basmati–1718*	136–138	4.5–5 t/ha	Delhi, Punjab and Haryana	Resistant to bacterial leaf blight
Pusa *basmati–1728*	140–145	5–6 t/ha	Punjab, Haryana, Delhi, Uttarakhand and Western Uttar Pradesh	Bacterial wilt resistant
Pusa *basmati–1637*	130	4.2 t/ha	Western Uttar Pradesh, Uttarakhand, Punjab, Haryana and National Capital Region of Delhi	Bacterial wilt resistant
Pusa *basmati–1509*	115	5 t/ha	Punjab, Haryana, Delhi, Western Uttar Pradesh, Uttarakhand and Jammu and Kashmir	Non-lodging and non-shattering
Pusa *basmati–1609*	120	4.6 t/ha	—	—

Improved Pusa *basmati–1*	—	—	Punjab, Haryana, Delhi, Western Uttar Pradesh, Uttarakhand and Jammu and Kashmir	Resistance against bacterial leaf blight disease
Pusa *basmati–1121*	145	4.5 t/ha	Punjab, Haryana, Delhi, Western Uttar Pradesh, Uttarakhand and Jammu and Kashmir	—
Pusa *basmati–1401*	140-145	5 t/ha	Punjab, Haryana, Western Uttar Pradesh and Uttarakhand	—
Pusa *basmati–1*	135–140	5–5.5 t/ha	Punjab, Haryana, Delhi, Western Uttar Pradesh, Uttarakhand and Jammu and Kashmir	—
Pusa–1592			Punjab, Haryana, Delhi, Western Uttar Pradesh, Uttarakhand and Jammu and Kashmir	Extra-long slender translucent grain with strong aroma
Pusa rice hybrid–10	110–115	7 t/ha	Delhi, Haryana and Uttarakhand	—

Aerobic rice varieties

Aerobic rice varieties are grown in well-drained, non-puddled and sporadic irrigation areas, and have an average yield of 4–5 tonnes per hectare. These are mostly cultivated on levelled and flat lands, where rains, with or without supplementary irrigation, are sufficient to support the crop for a full season. Aerobic rice is grown on a large scale in our country. Under this system, there is relatively more weed growth as compared to transplanted paddy and may encounter more species of weeds. Therefore, there is a need to control weeds by mechanical, chemical or integrated means. It is recommended to grow aerobic rice in rotation with the usual cropping system and other crops suitable for the given area.

Improved or recommended rice varieties for aerobic conditions in India

It has been found that most HYVs suitable for irrigated or wetland conditions are good for DSR in States

like Uttar Pradesh, Punjab, Haryana, Chhattisgarh, West Bengal, Bihar, etc. Besides, varieties like CR *Dhan*–200, *Piyari* (Odisha), CR *Dhan*–201 (Chhattisgarh and Bihar), CR *Dhan*–202 (Jharkhand and Odisha) and CR *Dhan*–204 (Jharkhand and Tamil Nadu) are suitable for aerobic rice cultivation. Rice varieties released by the University of Agricultural Sciences (UAS), Bengaluru, for DSR are ARB–6, MAS 946–1, MAS–26.

Practical Exercise

Activity

Identify common high yielding varieties of paddy.

Material required: practical file, pen, pencil, eraser, etc.

Procedure

- Visit the nearby paddy field.
- Talk to the farmer and identify the different varieties of paddy being grown there.
- Note down the names of the varieties that you have identified in the field.
- Write down the characteristics of the varieties that you have identified.
- Write down the growing purpose of each variety.
- Present it before the class.

Check Your Progress

A. Fill in the Blanks

1. High _____ varieties were the basic component of Green Revolution.
2. *Virendra* variety of rice was developed in the year _____.
3. *Basmati* rice has a special characteristic of having an _____.
4. *Basmati* rice is mainly produced in the _____ plains of India.
5. *Basmati* rice is resistant to _____ disease.

B. Multiple Choice Questions

1. What is the maturity period of RH–10 hybrid rice variety?
   (a) 110 days (b) 125 days
   (c) 140 days (d) 150 days

2. The total area under irrigated rice in India is about _____ million hectares.
   (a) 12 (b) 22 (c) 42 (d) 32
3. Popular rice varieties played an important role in _____.
   (a) Green Revolution (b) Brown Revolution
   (c) Yellow Revolution (d) White Revolution
4. *Satabdi is* a high yielding paddy variety, which has an yield potential of about _____ tonne/ha.
   (a) 5 (b) 7 (c) 8 (d) 10

C. Match the Columns

A Variety		B Duration (days)	
1.	*Abhishek*	(a)	105
2.	*Basmati*	(b)	90
3.	*Anjali*	(c)	120
4.	*Sadabahar*	(d)	130–140

D. Subjective Questions

1. Differentiate between the following.
   (a) HYVs and hybrids
   (b) Aromatic and aerobic rice varieties
2. Name two aromatic rice varieties produced in India.
3. Describe the aromatic rice varieties cultivated in different ecosystems of India.

SESSION 3: TRAITS OF RICE VARIETIES

As already mentioned, a number of rice varieties are grown in India. However, the quality of a rice variety is judged by its grain, such as its size, taste, aroma when cooked and colour. Besides, the variety must have optimum yield potential and stability over seasons.

Abiotic stress

Factors, such as extreme low and high temperature, drought, waterlogging or flooding, salinity, etc., adversely affect the growth of plants, yield and seed quality of crops.

Table 6.10: Rice hybrids tolerant to abiotic stress conditions

S. No.	Abiotic stress	Suitable hybrids
1	Rain-fed or upland	*Pant Sankar Dhan*–1, *Pant Sankar Dhan*–3, DRRH–2, KJTRH–4
2	Summer season	*Rajlaxmi*, CRHR–32, CRHR–4
3	Alkaline soil conditions	PHB–71, *Suruchi* (MPH–5401), JKRH–2000, DRRH–2, DRRH–2, CRHR–5, DRRH–44
4	Salinity (soil or water)	DRRH–28, JRH–8, PHB–71, *Pant Sankar Dhan*–3, KRH–2, HRI–148

Biotic stress

Biotic stress is caused by pathogens, insect–pests, weeds or intra-specific competition for resources, causing yield or quality loss.

Disease and insect–pests resistant varieties

Some institutions have been working on developing rice varieties and hybrids with an aim to introduce disease resistance in the crop. These developed varieties are high yielding, have resistance to diseases and are environment friendly. Improved *Samba Masuri* is resistant to bacterial blight and gives 15–30 per cent higher yield than other varieties that are not resistant to the disease.

Rice varieties to check malnutrition

Rice, though a staple crop in India and the world, is not a rich source of iron, zinc or Vitamin A. Insufficient iron intake may cause anaemia, retard brain development, and increased mortality, especially among women and children. If Vitamin A deficiency persists for a longer period, it may cause blindness. A variety called 'golden rice', which is the first of the Genetically Modified rice varieties, having high beta-carotene content, can help fight malnutrition problem. Other varieties fortified with zinc and iron are likely to be available in market in few years that will also help fight the problem.

Red rice varieties in India

Red rice (*O. longistaminata* and *O. punctata*) is a variety that is red in colour due to the presence of anthocyanin, which is a powerful antioxidant and may help boost

the immune system. Coloured rice is, usually, eaten un-hulled or partially hulled, and has a red husk and nutty flavour. Such a variety is rich in manganese, which strengthens plant metabolism. Likewise, magnesium helps in minimising the risk of migraine, blood pressure and heart problems. Red rice is, specifically, typical to the Himalayan and sub-mountainous areas like southern Tibet, Bhutan, etc. Several varieties in Madhya Pradesh, Maharashtra, as well as, southern India are also coloured. The varieties of red rice include the following.

Matta rice

This rice produced in Kerala is also known as 'red parboiled rice', '*Palakkadan Matta* rice', '*Rosematta* rice' and 'Kerala red rice'. It is an indigenous variety grown in Palakkad district of Kerala. It is popularly consumed in Kerala and Sri Lanka, for making idli, *appam* and is also eaten simply steamed.

Bhutanese red rice

It is medium grain rice native to Bhutan in the eastern Himalayas.

Thai red cargo rice

It is a non-glutinous long grain rice variety popular in Thailand and adjoining countries.

Practical Exercise

Activity

Identify biotic stress in a paddy field.

Material required: pen, pencil, notebook, etc.

Procedure

- Visit a nearby paddy field.
- Observe and identify the different types of biotic stress in the field.
- Note down the types of biotic stresses that you observe in the field.
- Present it before the class.

Check Your Progress

A. Fill in the Blanks

1. Biotic stress factors are caused by pathogens, insect–pests and _____.
2. The improved variety '*Samba Masuri*' carries resistance to _____.
3. The first Genetically Modified rice variety having high content of beta-carotene is _____.
4. *Matta* rice of Kerala is also known as red _____ rice.

B. Multiple Choice Questions

1. Red coloured variety of rice has _____ content.
   (a) anthocyanin (b) chlorophyll
   (c) carotene (d) lycopene
2. Thai red cargo rice variety is known for its _____.
   (a) non-glutinous nature (b) long grain
   (c) glutinous nature (d) Both (a) and (b)
3. A variety that can help manage malnutrition problems is _____.
   (a) red cargo rice (b) golden rice
   (c) glutinous (d)Both (a) and (b)
4. A suitable upland or rain-fed rice variety is _____.
   (a) *Pant Sankar Dhan*–1 (b) *Pant Sankar Dhan*–3
   (c) DRRH–2 (d) All of the above

C. Match the Columns

A	B
1. Red rice	(a) JRH-8
2. *Matta* rice	(b) Summer season variety
3. Salinity tolerant	(c) Indigenous rice of Kerala
4. *Rajlaxmi*	(d) *O. punctata*

D. Subjective Questions

1. Describe the following.
   (a) Biotic stress
   (b) Abiotic stress
   (c) Varieties of rice for malnutrition problems
   (d) Red rice varieties in India